Novel Technologies for Efficient NTP Reactor Decay Heat Removal and Utilization, Phase I

Completed Technology Project (2018 - 2019)

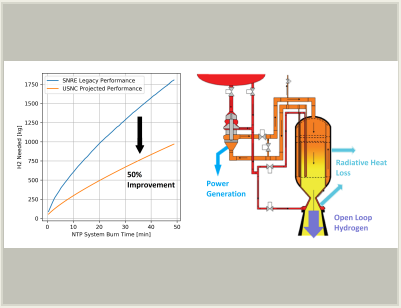
Project Introduction

In this SBIR, Ultra Safe Nuclear Corporation (USNC) will investigate and develop a set of novel technologies to minimize the amount of hydrogen needed for reactor decay heat removal after the shutdown of Nuclear Thermal Propulsion (NTP) systems. Decay heat is the energy deposited during the decay of radioactive fission products after the reactor shuts down. Its management is a critical issue for NTP systems. USNC's technology will be an effective, yet simple, solution to address decay heat removal. Central to USNC's optimized strategy for decay heat removal is maximizing the temperature that hydrogen is ejected and maximizing radiative heat transfer from the available surfaces of the rocket and nozzle. Furthermore, USNC's comprehensive solution generates small amounts of electrical power with the removed decay heat, increasing mission flexibility and resilience. Specifically, USNC will primarily investigate four technologies to minimize hydrogen usage: - The inclusion of coolant channels on the outside structure of the tie tube between the insulator and fuel that can heat hydrogen to hotter temperatures than the zirconium hydride moderator can maintain. - Circulating hydrogen through the tie tube and the outer structure of the core to maximize heat rejection by radiation. - Conversion of some of the heat into useful work through the addition of a power generation unit. - Using computationally-intensive optimization to find the best possible strategies and power cycle configurations to minimize the amount of hydrogen ejected from the system

Anticipated Benefits

NTP and its supporting technologies have great promise in spreading human presence to Mars and other locations beyond low earth orbit. USNC's optimized decay heat removal strategies will address key needs in NTP development to make it a viable technology to fulfill NASA human exploration needs. Furthermore, USNC will also provide documented work for hydrogen mass estimates for cooldown that will help in mission planning.

USNC and other companies are actively developing advanced, small, Earth-based reactors. USNC's Earth-based reactors are compact and, like NTP systems, require effective ways to deal with decay heat. The work in this SBIR will further USNC's Earth-based reactor work and may lead to strategies for dealing with decay heat in compact Earth-based reactors.



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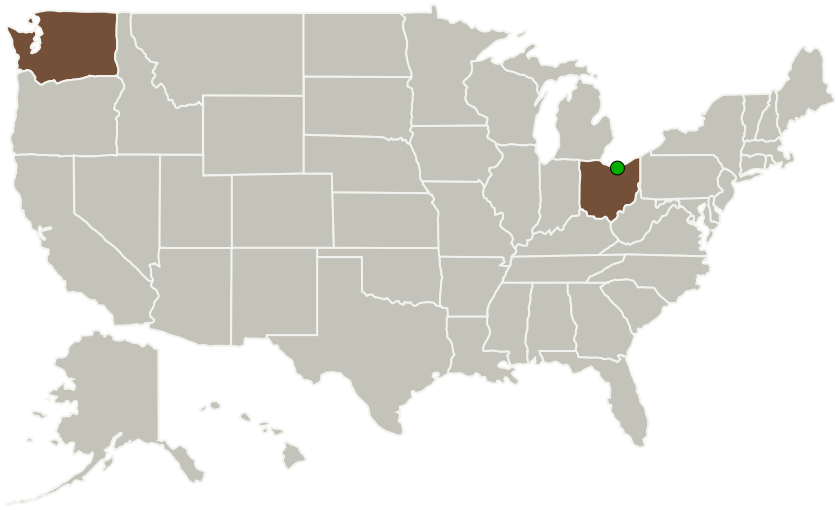
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Ultra Safe Nuclear Corporation	Lead Organization	Industry	Seattle, Washington
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Ohio	Washington

Project Transitions

July 2018: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141212)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Ultra Safe Nuclear Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Managers:

Thomas M Lavelle
Matthew C Deans

Principal Investigator:

Michael J Eades

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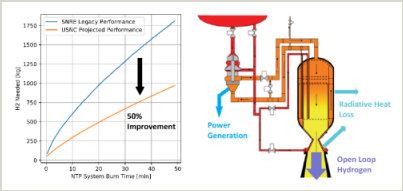
February 2019: Closed out

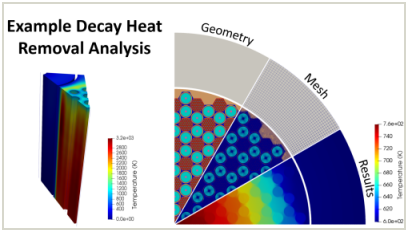
Closeout Documentation:

- Final Summary Chart PDF*(https://techport.nasa.gov/file/141213)*

Images



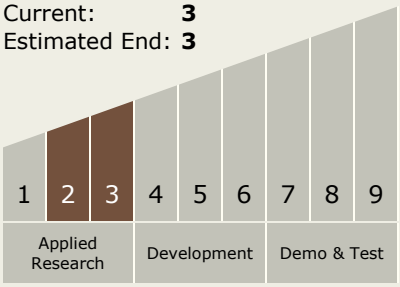
Briefing Chart Image
Novel Technologies for Efficient NTP Reactor Decay Heat Removal and Utilization, Phase I
(https://techport.nasa.gov/image/133403)



Final Summary Chart Image
Novel Technologies for Efficient NTP Reactor Decay Heat Removal and Utilization, Phase I
(https://techport.nasa.gov/image/132025)

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Target Destinations

Mars, Others Inside the Solar System